

Laparoscopic Supracervical Hysterectomy versus Laparoscopic-Assisted Vaginal Hysterectomy

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ABSTRACT

Objectives: To compare the incidence of perioperative complications and postoperative healthcare utilization and costs in laparoscopic supracervical hysterectomy (LSH) versus laparoscopic-assisted vaginal hysterectomy (LAVH) patients.

Methods: Women ≥ 18 years with LSH or LAVH were extracted using a large national commercial claims database from 1/1/2007 through 9/30/2008. Outcome was perioperative complications and gynecologic-related postoperative resource use and costs. Multivariate analysis was performed to compare postsurgical outcomes between the cohorts.

Results: The final sample consisted of 6,198 LSH patients and 14,181 LAVH patients. LSH patients were significantly more likely to have dysfunctional uterine bleeding and leiomyomas and less likely to have endometriosis and prolapse as the primary diagnosis, and also significantly more likely to have a uterus that weighed >250 grams than LAVH patients. Compared with LAVH patients, LSH patients had significantly lower overall infection rates (7.4% versus 6.2%, $P=.002$) and lower total gynecologic-related postoperative costs (\$252 versus \$385, $P<.001$, within 30 days of follow-up and \$350 versus \$569, $P<.001$, within 180 days of follow-up). Significant cost differences remained following multivariate adjustment for patient characteristics.

Conclusions: LSH patients demonstrated fewer perioperative complications and lower GYN-related postoperative costs compared to LAVH patients.

Key Words: Laparoscopic supracervical hysterectomy, Laparoscopic-assisted vaginal hysterectomy, Gynecologic-

related healthcare utilization and costs, Perioperative complications.

INTRODUCTION

Of major gynecologic surgical procedures, hysterectomy is the most prevalent worldwide and is second only to cesarean delivery in the United States (US).^{1,2} Over 600,000 women undergo hysterectomies each year in the US, and approximately one-third of women will have had the procedure performed by the age of 60 years.^{2,3,4} Hysterectomies can be performed using abdominal, vaginal, or laparoscopic approaches, and given the estimated \$5 billion in hospital charges resulting from this procedure annually, the outcomes and costs associated with each approach are important considerations.⁵

Choice of approach can be impacted by the indication for hysterectomy, with abdominal hysterectomies often used for gynecological cancers. Vaginal hysterectomies are more commonly performed for prolapse or menstrual disorders when the uterus is of normal or slightly enlarged size.^{2,5,6} Laparoscopic hysterectomies include laparoscopic supracervical hysterectomy (LSH), laparoscopic-assisted vaginal hysterectomy (LAVH), total laparoscopic hysterectomy and da Vinci hysterectomy. Both the American College of Obstetrics and Gynecology (ACOG) and the American Association of Gynecologic Laparoscopists (AAGL) support minimally invasive alternatives to abdominal hysterectomy, as these procedures are associated with lower surgical risks, shorter lengths of stay, and quicker return to normal activities than abdominal hysterectomy is.⁷ Warren et al⁴ also found significant cost savings associated with laparoscopic hysterectomy versus abdominal hysterectomy.

Several studies have compared LSH to LAVH evaluating operating time, blood loss, length of hospital stays, and morbidity rates. Findings suggest more favorable outcomes associated with LSH, although sample sizes were small and differences were not always significant.^{8,9,10,11}

The purpose of our study was to determine the incidence of perioperative complications, postoperative healthcare

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utilization, and costs in LSH versus LAVH patients, using a large, commercially insured population.

METHODS

Data Source

Data were derived from the Thomson Reuters MarketScan Commercial Claims and Encounter Database (Commercial Database) from the time period July 1, 2006 through March 31, 2009. The database is constructed from claims and enrollment data provided by over 130 large employer-sponsored health plans from across the US and is Health Insurance Portability and Accountability Act (HIPAA) compliant.

The Commercial Database contains the healthcare experience of privately insured individuals covered under a variety of fee-for-service, fully capitated, and partially capitated health plans. There were approximately 34.6 million covered lives in 2008. Utilization, outcomes, and cost data are captured across the full continuum of care for insurance reimbursable services delivered in all settings, including physician office visits, emergency room (ER) visits, hospital stays, and outpatient pharmacy claims. The age and sex distribution of patients in MarketScan are similar to that in the Medical Expenditure Panel Survey (MEPS), which is a nationally representative database.

Patient Selection

Women with evidence of LSH or LAVH between January 1, 2007 and September 30, 2008 were selected into 2 cohorts based on hysterectomy type, with July through December 2006 as the potential preperiod and October 2008 through March 2009 as the potential follow-up period. LSH was determined by the presence of a claim with any of the following codes: International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9-CM) procedure code 68.31, Current Procedural Terminology (CPT) codes 58541 – 58544, and CPT code 58548. Codes for LAVH included ICD-9-CM procedure code 68.51 and CPT codes 58550, 58552, 58553, and 58554. The date of the first LSH or LAVH procedure code in the selection period was assigned as the index date. Where both an ICD-9-CM procedure code and a CPT code indicating the same procedure appeared for the same patient, the ICD-9-CM procedure code in the inpatient setting was selected as the index date. Patients were required to have 6 months of continuous medical and prescription coverage prior to the index date and 6 months subsequent to the index date.

The postindex period included the index date. Patients were excluded if they were <18 years of age or if they had a diagnosis of cancer in the pre- or postindex periods (malignant neoplasms, ICD-9-CM diagnosis codes 140.xx through 209.xx, and carcinoma in situ and neoplasms of uncertain behavior, ICD-9-CM diagnosis codes 230.xx through 239.xx). Patients were also excluded if they had index date procedure codes for both LSH and LAVH (possibly due to coding errors) or if the length of stay (LOS) associated with the index procedure exceeded 20 days (based on the 99th percentile distribution of LOS).

Variables

A number of explanatory and outcome variables were determined. (Diagnosis, procedure, and drug codes used in their definition are available from the authors.)

Demographic variables were measured at index and included age, insurance plan type, geographic region, and urban versus rural residence. Clinical variables included the primary diagnoses on the index procedure claim; physician type on the index procedure claim; year of hysterectomy; emergent presentation, defined as an ER record associated with an inpatient admission for the index LSH or LAVH; a flag for the inpatient setting for the index LSH or LAVH; Charlson Comorbidity Index (CCI) score, Deyo version, separately for the preindex period and the index date, as well as counts by disease category; specific conditions of interest occurring in the preindex period and on index date based on both primary and secondary diagnosis codes and procedure codes; pelvic or abdominal surgeries occurring in the preindex period; medications of interest occurring in the preindex period; primary diagnosis on index date, and uterine weight at index.

Outcome variables included perioperative outcomes and gynecologic-related (GYN-related) postoperative resource utilization and costs. The perioperative outcomes included infection, procedure-specific complications, analgesic use, inpatient mortality, and injury. The number and percentage of patients with these outcomes were determined as were costs for claims containing diagnosis, procedure, and/or drug codes consistent with their definition within the 30 days following and including the index date. GYN-related postoperative outcomes included healthcare resource utilization for inpatient, ER, and outpatient service categories for claims containing codes consistent with a GYN condition within the 30 days following the index date or index admission discharge date and separately for the 6 months following the index date or index admission

discharge date (excluding the index procedure or admission itself). Diagnosis codes for GYN-related conditions can be found in Appendix 1. The number and percentage of patients, mean number of services, and costs were reported.

The costs for claims processed under a fee-for-service arrangement were the allowed charges (ie, the actual amounts paid by primary and secondary insurers plus patient cost share amounts [ie, copayments and deductibles]). The costs for claims processed under a capitated arrangement were estimated using the average cost of noncapitated claims, by procedure, geographic region, and year. All costs were adjusted to 2008 dollars using the medical service component of the Consumer Price Index (CPI).

Analyses

Descriptive analysis was performed on study variables, with counts and percentages reported for categorical variables and means (standard deviations [SDs]) reported for continuous variables. Statistical tests of significance for differences between the LSH and LAVH cohorts were conducted, with chi-square tests used to evaluate differences for categorical variables and *t* tests for continuous variables. Multivariate analysis was performed to compare outcomes between the LSH and LAVH cohorts. Logistic regression models were used to estimate the impact of hysterectomy type on clinical outcomes and utilization, with calculation of odds ratios (ORs), and generalized linear models (GLM) were used to estimate the impact on costs, with calculation of the marginal impact (ie, incremental cost difference). All multivariate analysis controlled for patients' demographic characteristics, comorbid

conditions, evidence of surgery in the preperiod, uterine weight, and diagnosis on the hysterectomy date.

RESULTS

A total of 13,551 and 31,232 women were selected with LSH and LAVH, respectively, from January 1, 2007 through September 30, 2008 (**Table 1**). Among them, 407 had claims for both LSH and LAVH, and 3 had an LOS of >20 days. They were excluded from the study. After screening for all inclusion and exclusion criteria, the final sample consisted of 6,198 LSH patients and 14,181 LAVH patients.

Demographic Characteristics

Mean age was 43.2 and 43.5 years for the LSH and LAVH cohorts, respectively (**Table 2**). A greater percentage of younger and older women (18 to 24, 25 to 34, and 55 to 64 years) underwent LAVH, while the reverse was true for middle-aged women (35 to 44 and 45 to 54 years) ($P < .05$ for all). The majority of patients were covered under health maintenance organization (HMO) and preferred provider organization (PPO) plans, approximately 80% from each cohort. Patients resided primarily in the South (57.7% of LSH and 61.2% of LAVH patients), followed by the North Central and West regions, and were in predominantly urban areas (82.7% of LSH and 75.0% of LAVH patients).

Clinical Characteristics

There was a low level of comorbidity in both cohorts, as indicated by the CCI score (**Table 3**). The only significant difference in individual comorbidities was in renal disease in the preindex period, with a higher percentage of LAVH

Table 1.
Sample Attrition

Criteria	LSH Patients		LAVH Patients	
	N	%	N	%
LSH or LAVH January 1, 2007 through September 30, 2008	13,551		31,232	
Continuous enrollment for 6-month preindex period	9,080	67.0	20,639	66.1
Continuous enrollment for 6-month postindex period	7,643	56.4	17,396	55.7
≥18 years of age	7,637	56.4	17,389	55.7
No cancer diagnosis in study period	6,605	48.7	14,591	46.7
Only LSH OR LAVH at index	6,198	45.7	14,184	45.4
Index hospitalization ≥20 days	6,198	45.7	14,181	45.4

Table 2.
Demographic Characteristics

Characteristic	LSH Patients		LAVH Patients		P Value
	N=6,198		N=14,181		
	N/Mean	%/SD	N/Mean	%/SD	
Age (years), Mean (SD)	43.2	6.5	43.5	7.8	.009
18–24	11	0.2	55	0.4	.015
25–34	575	9.3	1,785	12.6	<.001
35–44	2,914	47.0	5,984	42.2	<.001
45–54	2,461	39.7	5,223	36.8	<.001
55–64	237	3.8	1,134	8.0	<.001
Insurance Plan Type					
Comprehensive	104	1.7	298	2.1	.046
Exclusive Provider Organization (EPO)	79	1.3	115	0.8	.002
Health Maintenance Organization (HMO)	1,237	20.0	2,575	18.2	.002
Point of Service (POS)	572	9.2	1,558	11.0	<.001
Preferred Provider Organization (PPO)	3,798	61.3	8,829	62.3	.184
POS with Capitation	38	0.6	89	0.6	.904
Consumer Driven Health Plan (CDHP)	185	3.0	351	2.5	.036
Other	185	3.0	366	2.6	.102
Geographic Region					
Northeast	471	7.6	550	3.9	<.001
North Central	1,150	18.6	2,885	20.3	.003
South	3,576	57.7	8,684	61.2	<.001
West	983	15.9	2,021	14.3	.003
Unknown	18	0.3	41	0.3	.987
Urban/Rural Residence					
Urban	5,126	82.7	10,637	75.0	<.001
Rural	1,072	17.3	3,544	25.0	<.001

patients having renal disease. However, sample sizes were small, <1% in either cohort. Analgesic use occurred in 46% to 48% of LSH and LAVH patients in the preindex period, immunosuppressives in 16% to 17%, and antibiotics in 11% to 12%. Endometriosis was diagnosed (in both primary and secondary positions) in approximately 12% of the LSH and LAVH cohorts in the preindex period and in about 33% of the cohorts at index. In the preindex period, adhesions were diagnosed in 2% of each cohort, with all other conditions of interest occurring in <1% of patients. At index procedure, adhesions were diagnosed in 13.6% and 12.0% of the LSH and LAVH cohorts, respectively, and pelvic inflammatory disease was found in

about 2% of each cohort. All other conditions of interest at index occurred in <1% of patients. Surgery in the preindex period was uncommon, with the most frequently performed procedures being adhesiolysis and ovarian cystectomy, occurring in 1% of LSH and LAVH patients.

A greater percentage of the LSH cohort had dysfunctional uterine bleeding (32.6%) and leiomyomas (38.0%) as their primary diagnosis compared to the LAVH cohort (27.9% and 26.3%, respectively, $P<.001$ for both) (**Table 3**). Within the LAVH cohort, more patients had endometriosis (10.4%) and prolapse (8.0%) as the primary diagnosis, versus the LSH cohort (9.3%, $P=.008$ and 1.5%, $P<.001$,

Table 3.
Clinical Characteristics

Characteristic	Pre-Index Period					At Index				
	LSH Patients		LSH Patients		P-value	LAVH Patients		LAVH Patients		P-Value
	N=6,198		N=14,181			N=6,198		N=14,181		
	N/Mean	%/SD	N/Mean	%/SD	N/Mean	%/SD	N/Mean	%/SD		
Charlson Comorbidity Index^b										
CCI Score	0.11	0.37	0.12	0.40	0.327	0.03	0.18	0.03	0.21	.101
Chronic pulmonary disease	276	4.5	652	4.6	0.649	65	1.0	170	1.2	.356
Rheumatologic disease	59	1.0	126	0.9	0.661	4	0.1	13	0.1	.537
Diabetes (mild/moderate)	221	3.6	504	3.6	0.967	92	1.5	207	1.5	.893
Renal disease	7	0.1	37	0.3	0.036	2	0.0	7	0.0	.593
Medication Use										
GnRH agonists	220	3.5	314	2.2	<0.001	N/A ^a				
Analgesics	2,961	47.8	6,485	45.7	0.007					
Antibiotics	666	10.7	1,644	11.6	0.079					
Immunosuppressives	985	15.9	2,348	16.6	0.238					
Conditions of Interest										
Adhesions (and adhesiolysis)	147	2.4	302	2.1	0.279	840	13.6	1,704	12.0	.002
Endometriosis	730	11.8	1,735	12.2	0.358	2,035	32.8	4,664	32.9	.938
Pelvic inflammatory disease	58	0.9	121	0.9	0.561	98	1.6	224	1.6	.993
Deep vein thrombosis	19	0.3	35	0.2	0.445	1	0.0	5	0.0	.464
Pulmonary embolism	8	0.1	19	0.1	0.929	3	0.0	5	0.0	.663
Inflammatory bowel disease	15	0.2	53	0.4	0.134	8	0.1	23	0.2	.577
Ulcerative colitis	7	0.1	34	0.2	0.063	1	0.0	7	0.0	.271
Crohn's disease	8	0.1	21	0.1	0.74	7	0.1	17	0.1	.894
Surgeries										
Adhesiolysis	62	1.0	132	0.9	0.638	N/A ^a				
Unilateral/bilateral adnexectomy	12	0.2	65	0.5	0.005					
Myomectomy	4	0.1	5	0.0	0.36					
Ruptured appendix	0	0.0	0	0.0	–					
Ovarian cystectomy	53	0.9	162	1.1	0.065					
Exploratory laparoscopy	13	0.2	44	0.3	0.211					
Dialysis	1	0.0	4	0.0	0.613					
Primary Diagnosis										
Dysfunctional uterine bleeding	N/A ^a					2,020	32.6	3,961	27.9	<.001
Leiomyomas						2,353	38.0	3,723	26.3	<.001
Endometriosis						574	9.3	1,474	10.4	.008
Prolapse						90	1.5	1,141	8.0	<.001
Adhesions						32	0.5	66	0.5	.629

Table 3 continued on next page.

Table 3. (continued)
Clinical Characteristics

Characteristic	Pre-Index Period				At Index					
	LSH Patients		LSH Patients		P-value	LAVH Patients		P-Value		
	N=6,198		N=14,181			N=6,198	N=14,181			
N/Mean	%/SD	N/Mean	%/SD	N/Mean	%/SD	N/Mean	%/SD			
Other	1,129	18.2	3,816	26.9	<.001					
Year of Hysterectomy										
2007	N/A ^a					3,271	52.8	8,278	58.4	<.001
2008						2,927	47.2	5,903	41.6	<.001
Uterine Weight										
≤250 grams	N/A ^a					4,940	79.7	12,548	88.5	<.001
>250 grams						1,019	16.4	1,466	10.3	<.001
Not specified						239	3.9	167	1.2	<.001

N/A=not applicable, ie, characteristic not measured in period.

^bValues were reported for mean CCI score and for counts of individual diseases used in score. Individual disease counts were reported for diseases where at least 1% of patients had disease in either the preperiod or at index or where P-value was significant at <.05.

respectively). LSH patients were significantly more likely to have a uterus that weighed >250 grams (16.4%), compared to LAVH patients (10.3%, P<.001). Physician specialty at index for over 75% of each cohort was obstetrics and gynecology (data not reported in table). LAVH patients were significantly more likely to have their procedures performed in the inpatient setting than LSH patients (49.5% versus 36.6%, P<.001) (data not reported in table). Less than 1% of LSH and LAVH patients had their inpatient procedure performed following an ER visit (data not reported in table).

Index and Perioperative Outcomes and Costs

LAVH patients had significantly higher overall infection rates compared to LSH patients (7.4% versus 6.2%, P=.002) primarily due to increased urinary tract infections (4.1% versus 3.0%, P<.001) (Table 4). Analgesic use was also higher in LAVH patients (79.4% versus 75.3%, P<.001), driven by opiate use (76.5% versus 72.0%, P<.001). While costs associated with analgesic use were greater in the LAVH patients (P=.03), no other significant cost differences were found in the indexing event or in perioperative outcomes of interest.

GYN-Related Postoperative Resource Use and Costs

The percentage of patients with an inpatient readmission after the index procedure was significantly lower

in the LSH cohort than in the LAVH cohort (1.9% versus 3.3%, P<.001, within 30 days of follow-up and 2.4% versus 3.8%, P<.001, within 180 days of follow-up) (Table 5). While LOS for these postoperative inpatient admissions was longer in the LSH than the LAVH cohort (P<.001 for both follow-up periods), the difference was small in magnitude (0.15 to 0.16 days). The percentage of patients with an ICU stay was also lower in the LSH versus LAVH cohorts (P<.001 for both follow-up periods). LSH patients had a significantly lower mean number of GYN-related outpatient office visits in both the 30-day and 180-day follow-up periods (P<.001 for both), driven primarily by a lower mean number of primary care visits. Overall, LSH patients had significantly lower total GYN-related costs (\$252 versus \$385, P<.001, within 30 days of follow-up and \$350 versus \$569, P<.001, within 180 days of follow-up).

Multivariate Regression Results

The LSH cohort had a significantly lower risk of infection compared to the LAVH cohort (OR 0.830, P=.004) (Table 6). Significant differences in favor of LSH were also found for hematologic complications and analgesic use. For both the 30-day and 180-day follow-up periods, the LSH cohort had significantly lower risks of GYN-related inpatient readmissions, ER visits, and outpatient office visits. The total GYN-related postoperative costs were

Table 4.
Index and Perioperative Outcomes: Occurrence and Costs During Index Procedure and in 30-Day Follow-up Period

Outcome	LSH Patients		LAVH Patients		P-Value
	N=6,198		N=14,181		
	N/Mean	%/SD	N/Mean	%/SD	
Occurrence of:					
Infection	383	6.2	1,046	7.4	.002
Acute lymphadenitis	0	0.0	1	0.0	.509
Cellulitis/skin abscesses	37	0.6	90	0.6	.753
Infection of colostomy or enterostomy	0	0.0	0	0.0	–
Intra-abdominal abscess or suppurative peritonitis	14	0.2	34	0.2	.851
Local skin infections	9	0.1	12	0.1	.215
Pelvic organ infection	119	1.9	294	2.1	.475
Posttraumatic wound infection	1	0.0	2	0.0	.912
Pulmonary infection	45	0.7	107	0.8	.828
Rectal abscess	0	0.0	1	0.0	.509
Retroperitoneal infection	1	0.0	2	0.0	.912
Sepsis	8	0.1	18	0.1	.969
Urinary tract infection	186	3.0	582	4.1	<.001
Antibiotics initiated 3 days after index date	220	3.5	562	4.0	.157
Days of antibiotic use	6.35	3.67	6.88	5.67	.165
Procedure-specific Complications	1,364	22.0	3,255	23.0	.138
Pulmonary	182	2.9	457	3.2	.281
Cardiac	12	0.2	25	0.2	.789
Vascular/thromboembolic	25	0.4	59	0.4	.896
Shock	3	0.0	4	0.0	.474
Neurological	7	0.1	13	0.1	.656
Gastrointestinal tract	396	6.4	878	6.2	.592
Genitourinary	653	10.5	1,473	10.4	.75
Hematologic	152	2.5	476	3.4	<.001
Vaginal dehiscence (same day)	1	0.0	15	0.1	.036
Vaginal dehiscence (within 30 days)	1	0.0	15	0.1	.036
Incisional hernia	21	0.3	25	0.2	.025
Trachelectomy	5	0.1	3	0.0	.048
Other	203	3.3	602	4.2	.001
Analgesic Use	4,670	75.3	11,255	79.4	<.001
Opiate	4,460	72.0	10,849	76.5	<.001
Non-opiate	2,141	34.5	4,974	35.1	.464
Inpatient Mortality	0	0.0	0	0.0	–
Injury	33	0.5	110	0.8	.056

Table 4 continued on next page.

Table 4. (continued)

Index and Perioperative Outcomes: Occurrence and Costs During Index Procedure and in 30-Day Follow-up Period

Outcome	LSH Patients		LAVH Patients		P-Value
	N=6,198		N=14,181		
	N/Mean	%/SD	N/Mean	%/SD	
Costs of:					
Infection	\$267	\$2,616	\$396	\$8,017	.21
Procedure-specific Complications	\$1,280	\$10,455	\$1,154	\$5,699	.27
Analgesic Use	\$14	\$50	\$15	\$36	.03
Index Event	\$10,498	\$10,285	\$10,583	\$9,167	.56

\$108 and \$174 less for the LSH cohort compared to the LAVH cohort in the 30-day and 180-day follow-up periods, respectively (P<.001 for both).

DISCUSSION

The current study found distinct differences between the LSH and LAVH cohorts. LSH patients were more likely to have a hysterectomy due to dysfunctional uterine bleeding and leiomyomas and less likely to undergo the procedure due to endometriosis and prolapse. Unadjusted analyses showed lower rates of overall infection and procedure-specific complications in LSH patients. Compared to LAVH patients, LSH patients had a lower number of GYN-related outpatient office visits and lower total GYN-related costs in both the 30-day and 180-day follow-up periods. Adjusted analyses found significant differences in favor of LSH with regard to the occurrence of overall infection, hematologic complication, and analgesic use despite the fact that LSH patients were also more likely than LAVH patients to have a uterus that weighed >250 grams.

The marginal impact on costs was also in favor of LSH, with \$108 and \$174 less in incurred total GYN-related costs in the 30-day and 180-day follow-up periods, respectively. Wu et al¹² estimated that 538,722 hysterectomies for benign disease were performed in 2003, and 11.2% of them were done through the laparoscopic route, which suggests a total of 60,337 laparoscopic hysterectomies. If we assume 40% of these laparoscopic hysterectomies were performed using the LSH procedure rather than the LAVH procedure, the cost savings would be \$2.6 million and \$4.2 million in the 30-day and 180-day follow-up periods, respectively.

These results, while consistent with much of the previous work comparing LSH and LAVH, are important in

that the size of the study cohorts allowed for a robust comparison of the 2 procedures using a diverse, commercially insured population, and thus add further support to the existing evidence demonstrating improved outcomes and fewer costs with LSH. The study by Milad et al⁸ was a cohort analysis of 132 patients, 27 undergoing LSH and 105 undergoing LAVH, from a university based medical center. Lalonde et al⁹ performed an office and hospital chart review and conducted a postoperative questionnaire on 40 patients, equally divided between LSH and LAVH patients, from a private gynecology practice and private hospital. El-Mowafi et al¹⁰ studied 259 patients, 123 with LSH and 136 with LAVH, from US and non-US sites.

Hospital stays for LSH patients compared to LAVH patients were significantly shorter in Milad et al⁸ and Lalonde et al⁹ and showed no difference in El-Mowafi et al.¹⁰ Though our study did not examine the LOS for the index procedure, LAVH patients were significantly more likely to have their procedures performed in the inpatient setting. Hysterectomy costs were significantly less for LSH versus LAVH patients in both Milad et al⁸ and Lalonde et al⁹ but showed no difference in our study. However, hysterectomy costs in Milad et al⁸ and Lalonde et al⁹ were calculated from hospital costs, while costs in our study were calculated from both inpatient and outpatient costs, depending on where the hysterectomy was performed. Further work is needed to evaluate cost differences based on setting of care.

Though defined differently, the current study as well as the 3 previous studies (Milad et al,⁸ Lalonde et al,⁹ and El-Mowafi et al¹⁰) found fewer complications in the LSH patients. The current study also found significantly lower

Table 5.
GYN-related Resource Utilization and Costs in 30-Day and 180-Day Follow-up Periods

Outcome	30-day Follow-up Period					180-day Follow-up Period				
	LSH Patients		LAVH Patients		P-value	LSH Patients		LAVH Patients		P-value
	N=6,198		N=14,181			N=6,198		N=14,181		
N/Mean	%/SD	N/Mean	%/SD		N/Mean	%/SD	N/Mean	%/SD		
Utilization by Service Category:^a										
Inpatient admissions										
Patient had admission	119	1.9%	461	3.3%	<.001	149	2.4%	545	3.8%	<.001
# of admissions	0.02	0.14	0.03	0.19	<.001	0.03	0.17	0.04	0.22	<.001
Length of stay (days)	2.70	2.67	2.54	2.74	<.001	2.57	2.55	2.42	2.54	<.001
ICU stay	3	0.0%	11	0.1%	<.001	4	0.1%	18	0.1%	<.001
Re-admission rate ^b	1	0.04%	7	0.10%	.429	2	0.09%	25	0.35%	.038
ER visits										
Patient had ER visit	67	1.1%	235	1.7%	.095	115	1.9%	340	2.4%	.123
# of ER visits	0.020	0.267	0.029	0.267	.355	0.041	0.557	0.045	0.352	.268
Outpatient visits and services										
# of office visits	0.068	0.484	0.086	0.424	<.001	0.293	1.156	0.361	1.427	<.001
# of primary care visits	0.055	0.465	0.068	0.359	<.001	0.217	0.972	0.262	1.088	<.001
# specialty visits	0.010	0.120	0.017	0.215	.018	0.060	0.350	0.084	0.715	.009
# of other office visits	0.002	0.067	0.002	0.059	.001	0.015	0.463	0.014	0.528	.99
# of outpatient services	0.222	0.937	0.267	1.010	<.001	0.516	1.767	0.623	1.997	<.001
Costs by Service Category:^a										
Total	\$252	\$1,594	\$385	\$2,720	<.001	\$350	\$2,056	\$569	\$4,509	<.001
Inpatient	\$138	\$1,471	\$270	\$2,645	<.001	\$189	\$1,870	\$387	\$4,372	<.001
ER	\$5	\$75	\$6	\$66	.137	\$8	\$88	\$10	\$96	.126
Outpatient visits and services	\$109	\$527	\$108	\$581	<.001	\$153	\$628	\$171	\$758	<.001

^aGYN-related utilization and costs were identified using all claims with a primary or secondary non rule-out diagnosis containing codes consistent with GYN-related medical care.

^bRe-admission rate is reported only for patients whose procedure was performed in the inpatient setting.

GYN-related postoperative costs in LSH versus LAVH patients.

In addition to the commonly recognized constraints of administrative claims data,¹³ limitations specific to this study should be noted when interpreting the results. First, selection of LSH versus LAVH patients was based on the occurrence of specific procedure codes in the claims history and thus is dependent on the accuracy of these codes. However, because these are distinct surgeries and because we excluded patients with both types of codes, we would expect any misclassification to be small. Second, although we attempted to control for confounding variables in the multivariate re-

gression analyses, other factors not captured in administrative claims data, such as information on level of experience of the surgeon or information on other patient factors that drive surgeon preference for LSH versus LAVH, may have impacted results. Finally, the study population comprised commercially insured patients covered with large employers, thus results may not be representative of all patients with hysterectomy in the US, especially the uninsured or those covered by Medicaid. In addition, more than half of the study population lived in the South, and the regional distribution of the study sample does not represent the regional distribution of the US.

Table 6.
Impact of LSH Versus LAVH on Outcomes: Multivariate Regression Results^a

Outcome	Length of Follow-up Period (Days)	Measure	P Value
		Odds Ratio or Marginal Impact (\$)	
Peri-operative Outcomes			
Presence of:			
Infection	30	0.830	.004
Pelvic organ infection	30	0.903	.366
Procedure-specific complications	30	0.947	.152
Pulmonary complication	30	0.888	.195
Gastrointestinal tract complication	30	1.017	.795
Genitourinary complication	30	1.060	.261
Hematologic complication	30	0.667	<.001
Analgesic use	30	0.812	<.001
Costs of:			
Infection	30	-\$62.5	.145
Procedure-specific complications	30	\$93.4	.340
Analgesic use	30	-\$1.1	.019
Sum of the costs above	30	\$43.6	.725
GYN-related Outcomes			
Presence of:			
Inpatient admission	30	0.610	<.001
	180	0.640	<.001
ER visit	30	0.649	.003
	180	0.782	.028
Physician office visit	30	0.764	<.001
	180	0.847	<.001
Costs of:			
Total	30	-\$108	<.001
	180	-\$174	<.001
Inpatient	30	-\$121	<.001
	180	-\$172	<.001
Outpatient (including ER)	30	\$8	.365
	180	-\$8	.474
Outpatient (excluding ER)	30	\$10	.245
	180	-\$6	.591

^a Reference=LAVH for all models.

CONCLUSION

LSH patients demonstrated fewer perioperative complications and lower GYN-related postoperative costs

compared to LAVH patients. Additional comparison of these 2 laparoscopic approaches to hysterectomy is needed to further clarify the clinical and cost effectiveness of each procedure.

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Appendix 1.

ICD-9-CM Diagnosis Codes for GYN-Related Conditions

ICD-9-CM Diagnosis Code	Description
593.3x	Stricture or kinking of ureter
593.4x	Other ureteric obstruction
593.82	Other specified disorders of kidney and ureter: Ureteral fistula
593.89	Other specified disorders of kidney and ureter: Other
595.xx	Cystitis
599.0x	Urethral stricture due to infection
599.6x	Urinary obstruction, unspecified
614.xx	Inflammatory disease of ovary, fallopian tube, pelvic cellular tissue, and peritoneum
616.xx	Inflammatory disease of cervix, vagina, and vulva
617.xx	Endometriosis
618.xx	Genital prolapse
619.xx	Fistula involving female genital tract
620.6x	Broad ligament laceration syndrome
620.7x	Hematoma of broad ligament
622.xx	Noninflammatory disorders of cervix
623.2x	Stricture or atresia of vagina
623.4x	Old vaginal laceration
623.6x	Vaginal hematoma
625.xx	Pain and other symptoms associated with female genital organs
629.0x	Hematocele, female, not elsewhere classified
867.xx	Injury to pelvic organs
868.xx	Injury to other intra-abdominal organs
902.xx	Injury to blood vessels of abdomen and pelvis
996.xx	Complications peculiar to certain specified procedures
998.xx	Other complications of procedures, NEC